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Matter, Ether, and Motion. The Factors and Relations of Physical Science. By *A. E. Dolbear*, Ph. D., Professor of Physics, Tufts College. Boston: Lee and Shepard. 1894. Pp. 407. Price, $2.00.

The English-speaking world has little reason to complain of a dearth of popular treatises of science. To speak only of physics, nearly every master of that science has left some splendid and comforting memorial that the verified truths and accredited hypotheses of science, however dim or abstruse their origin, can, at some period of their development, be stated in plain and simple terms and be made intelligible to clear and unbiassed minds of all professions. Yet the example, the classical ideal, set by men like Faraday, is not always followed—not completely followed even by men of Faraday's approximate intellectual stature, and infinitely less so by spirits of a more subaltern cast. Addressing an audience in the main credulous, and prepared by long mistraining to expect and to accept only marvellous revelations, the popular expositor of science is exposed to temptations which yielded to, fully justify the stigma that cleaves to the literal English rendering of his title's French equivalent—the *vulgariser*. Frequently, a novelty, which discharges no function in the method or in the practise of science, is exalted to the dignity of a principle and treated with the impressive particularity which properly belongs only to important truths. Science, like society, has its fads. But the scientist, whose mental anchor does not drag, is perfectly aware that these erratic strayings of his thoughts do not constitute the serious business of his profession, and when he indulges in such cerebral antics, he usually does so with a consciousness and underplay of humor which from his point of view fully excuses him. But with the uninitiated, trustful public it is different. Here the mental excursions of the physicist only astound and mystify, and, being accepted as truths, convey an entirely wrong impression of what science is, and scarcely any of what it accomplishes.

Of no epoch of scientific development is this more true than of the present. Great as the advance of science has been in the last fifty years, so great indeed that with some liberty of expression the epithet "revolutionary" may seem justly applied to it, it is yet an exaggeration to say, with Professor Dolbear, that more *knowledge* has been acquired in this time than in all the preceding centuries (p. 384). In scientific freaks it does stand above all the preceding centuries, but, with the exception of three or four ideas, (which had their root in earlier thought,) the science of the epoch indicated is distinguished from that of the two preceding centuries by nothing more remarkable than an increased zeal in the domain of plodding specialised research. When the time for its criticism comes, it will not be said that the knowledge thus acquired "is in the nature of a catastrophe where old continents have sunk and new ones have arisen from ocean beds."

But enough of retrospect. The text-books have not kept pace with this revolutionary advance of science, and Professor Dolbear's book is written to meet the wants of a large body of persons who desire to know the contemporary state of natural philosophy and who have neither the time nor opportunity to read and digest the thousands of monographs which record that advance. Really, the book is more than this. In a clear, smooth style, Professor Dolbear expounds the scope and import of the chief ideas of modern physics, as they take shape in his philosophy, and from his expositions the critical reader will derive much profit and stimulus. If he has not solved all his problems, he at least leaves the most of them in a shape which will make their solution easier for others. And this is much. More difficult than the solution, often, is the proper formulation of a problem. For, properly formulated, a problem sometimes turns out not to be a problem, and its solution is accordingly dispensed with.

Leaving aside the solid kernel of the work, we shall now simply advert to a few points on which Professor Dolbear's views may be criticised, first affixing here the titles of the chapters of the book, which are: "Matter and Its Properties," "The Ether," "Motion," "Energy," "Gravitation," "Heat," "Ether Waves," "Electricity," "Chemism," "Sound," "Life," "Physical Fields," "On Machines and Mechanism," "Properties of Matter as Modes of Motion," "Implications of Physical Phenomena," "Relations of Physical and Psychical Phenomena."

Professor Dolbear accepts *in toto* the mechanical view of the universe. First, all *physical* phenomena are reducible to the principles of mechanics, and atoms and molecules are subject to them as much as masses of visible magnitude; however different one phenomenon is from another the factors of both are the same—*matter, ether, motion.* "The visible universe may be conceived as a vast machine within which motions are being exchanged by contact and radiation." Matter is defined generally as anything which possesses the property of gravitative attraction. The existence of an ether is supposed, not asserting gravitative action, and hence different from matter, but in all probability *by some kind of a vortex motion* making up matter. As to gravity, there can be little doubt that the ether is concerned in it. "One cannot but see that it [the ether] is a storehouse of an almost unlimited "amount of energy of many kinds; so that if every particle of matter were in"stantly annihilated, there would still be a universe filled with energy, though it "would not be serviceable, because lacking the conditions for transformation into "useful forms. This may be said to be one of the functions of matter—the trans"formation of the energy it gets from the ether." Second, as to *vital* phenomena Professor Dolbear accepts the theory, which has the weighty advocacy of Haeckel and nearly all great naturalists, that the ultimate explanation of all biological phenomena must be mechanical. "It is clear," he says, "that the solution of every "ultimate question in biology is to be found only in physics, for it is the province "of physics to discover the antecedents as well as the consequents of all modes of "motion."

It is hard to go behind a mechanical explanation of vital phenomena, more so behind a mechanical explanation of physical phenomena. But although the opponents of the latter are few and isolated, the opponents of the former are not; and such passages as the following, supported though they are by eminent authorities, give a wrong impression: "What seemed probable forty years ago, to those who were "conversant with the facts,—that vital force as an entity has no existence, and that "all physiological phenomena whatever can be accounted for without going beyond "the bounds of physical and chemical science,—has to-day become the general con- "clusion of all students of vital phenomena; and vital force as an entity has no ad- "vocates in the present generation of biologists. The term has completely disap- "peared from the science, and is only to be found in historical works." Applied to the old vitalism, this statement is true. But it overlooks a strong and important movement in biology and philosophy, which wrong or right, reactionary or progressive, still exists and even employs the name of vitalism. It is represented (in the scientific field) by Hanstein, Marilaun, Rindfleisch, and less mystically by Bunge and Binet. (See Max Verworn's article "Modern Physiology," *The Monist*, Vol. IV, No. 3, and the preface to A. Binet's *Psychic Life of Micro-Organisms.*)

We will next mention some of the implications of the new physical hypotheses in the inanimate field, and seize the opportunity of seeing how an hypothesis can throw light upon itself. According to Professor Dolbear we have in natural phenomena matter, and ether, and space, and time, and motion. "If matter and "ether be substances, then the product of one into the other would signify nothing; "it would be physical nonsense. So likewise would be the product of matter into "space or time; and yet if matter is to be possessed of energy, and motion is *not* "one of the factors, then either space or time must be, and no one can imagine "how energy can in any way depend upon time as a factor, and there is no degree "of probability that it is or can be so; and hence, though we had no hint of how it "might be, one would need to avow his belief that in some way motion was involved "in every case where physical energy was involved, for in any case where it had "been hitherto possible to trace it, it had been found to be present as a factor in "precisely the same relations as in all other known cases, and hence he would avow "a disbelief in the existence of potential energy in any other than a loose sense for "a condition where the character of the motion involved was obscure. This would "imply that all energy is kinetic, whether the character of the motion was deter- "mined or not. This view is now held by those who have taken the pains to think "out the necessary relations that are involved in this subject." It follows from this that potential energy must in some way depend upon motion (Tait). And, in another place, the conclusion is stated that *inertia, too, must be looked upon as probably due to motion.*

Again, since at absolute zero there is no cohesion, *hardness* cannot be a property of atoms; from another property of the absolute zero, *color* cannot be affirmed of atoms. "*An atom is a particular form of motion of the ether in the ether.*" Impenetrability is an unwarrantable assumption. Even "such differences between "*the atoms of the elements as are called their masses, are due to the relative rates* "*of rotation* [of ether within the ether]." The world is reducible to motion and ether, and by this explanation is rendered more mysterious than it was without the explanation. "The mystery of phenomena is not lessened but made greater by the "discovery that everything which affects our senses in every degree is finally re"solvable into a substance having physical properties so utterly unlike the proper"ties of what we call matter, that it is a misuse of terms to call it matter."

When we reason from facts to facts, even such as are beyond the range of experience, we are pursuing science; when we reason from *assumptions* to facts beyond the reach of experience, we are pursuing metaphysics. Much of the new physical ontology suffers by this error. We should never forget that in following out to their logical conclusions the implications of the assumptions made or suggested by science regarding atoms and ethers and molecules, we are extending conceptions which are not based upon facts, and which are not always subject to experimental control; that we may be applying such assumptions to cases to which they do not belong, and so be doing in physics what the ontologists did in philosophy when they sought to deduce the world from the notion of Being, Non-Being, etc., etc.

With respect to the "absolute scale of temperature," this is simply a scale reckoned from a supposed point, where the tension of a gas is zero. If without the limits of experience things were the same as they are within those limits, that point would be —273° Celsius. But, useful and convenient as this scale is as a scientific tool, it does not follow from it that a temperature-point is producible at which the tension of a gas is equal to zero, nor that a lower degree of temperature is impossible. Consequently, to accept that scale as absolute, in the absolute sense, and to juggle out of it the properties of matter, of atoms, or of ether, is logically inadmissible.

Professor Dolbear lays considerable stress upon his treatment of "physical fields"—all analogies of fields of force. We shall mention only one point here, which will reveal the author's attitude to the revelations of the new psychical sciences. As there is a magnetic field, an electrical field, a thermal field, etc., so, Professor Dolbear asserts, (on the ground of phenomena of sympathy,) there is a *brain-field*. His idea seems to be that there is such a thing as cerebral induction. Still, "this is not to be understood as asserting that . . . . thought-transference "actually occurs. All that is asserted is that the physical conditions necessary for "such transference actually exist, and one who was acquainted with the properties "of physical fields would certainly predict the possibility of thought-transference "in certain cases."

In the two last chapters of the book Professor Dolbear puts some very hard questions to the spiritualists. But he is lenient, after all, to their aspirations. We shall close therefore with a quotation which will show his attitude towards the momentous questions of modern "psychics": "No one may assume for an instant "that the possibilities of ether phenomena are limited by such interactions as have "hitherto found expression in treatises on physics. Indeed, there is already a body "of evidence which cannot safely be ignored, that physical phenomena sometimes "take place when all the ordinary physical antecedents are absent, when bodies "move without touch or electric or magnetic agencies,—movements which are "orderly, and more or less subject to volition. In addition to this is still other evi-"dence of competent critical observers that the subject-matter of thought is directly "transferable from one mind to another. Such things are now well vouched for, "and those who have not chanced to be a witness have no *a priori* right from phys-"ics or philosophy to deny such statements. Such facts do not in any way invali-"date physical laws, nor make it needful to modify present statements concerning "energy. Physical laws are not compulsory; they *rule* nothing; they are but state-"ments of our more or less uniform experience. If these things be true, they are "of more importance to philosophy than the whole body of physical knowledge we "now have, and of vast importance to humanity; for it gives to religion corrobo-"rative testimony of the real existence of possibilities for which it has always con-"tended. The antecedent improbabilities of such occurrences as have been called "miracles, which were very great because they were plainly incompatible with the "commonly held theory of matter and its forces, have been removed, and their "antecedent probabilities greatly strengthened by this new knowledge; and reli-"gion will soon be able to be aggressive with a new weapon." T. J. McC.

THE HISTORY OF TRADE UNIONISM. By *Sidney* and *Beatrice Webb*. London: Longmans. 1894. Pp. 558. Price, $5.00.

The bulk and broad title of this work sharpen an expectation of more than it actually presents. It does not give a history of Trade Unionism generally, but of *English* Trade Unionism particularly. It does not afford a complete picture of the origin or growth or organisation or activity of any one of the great Trade Unions of Great Britain, but confines itself rather to a history of the general movement of those combinations. Neither is it critical: "all analysis of the economic effects of trade union action is reserved for a subsequent volume on the Problems of Trade Unionism"; and then,—so the authors, with probably a consciousness of omission promise us,—the annals of the separate unions will be more fully drawn upon.

The vivacity of thought and action, characteristic of European civilisation during the eighteenth century, was especially marked in economic affairs. Invention grew apace; the industry of the gilds was felt to be cramped and the modern factory system gradually asserted itself,—at first slowly, but at length toward the close of the last century with crushing strength. Instead of an industrial organisation in which the humble apprentice might reasonably hope, albeit by slow stages, yet surely to attain to a mastership, with its concomitant possession of raw materials, of means of production, of security against over-hot competition, of placid enjoyment of the fruits of industry, in short of *otium cum dignitate*,—industry assumed a new form in which the toilers remained, their life long, hopeless toilers, and the masters were such, not by reason of long service and preparation, but of *capital!*